MISSOURI BOTANICAL GARDEN BULLETIN

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Missouri Vegetation and an English Mathematician

Book Review: Wells' Plant Propagation Practices

Volume XLIV January, 1956 Number 1

Another article about the Ozarks appears in this issue. It is part of a series by various authors presenting different points of view about this interesting region so close to St. Louis — its past, its present, and its future. We are indebted to Leonard Hall not only for the article but for arranging for permission to use the line drawings from the *St. Louis Post Dispatch* and the photograph by Charles Swartz of the Conservation Commission.

COVER:—A farm pond in the Ozarks. Photograph courtesy Radio Station KETC

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Missouri Botanical Garden Bulletin

Vol. XLIV JANUARY, 1956 No.1

THE OZARKS COME BACK

LEONARD HALL, Possum Trot Farm
AND
LEON HORNKOHL, U. S. Forest Service

THERE was a time, long ago, when the Missouri Ozarks was a land of abundance, as pioneer communities know abundance. Then through the years it deteriorated into a place of poverty so that John Gunther was able to designate it, with some truth, one of the "slum citadels of America." Today it is once again a land of hope and restoration where residents look with considerable confidence to a better future. The story of how all this came about lies in the land and the people; but chiefly in the land—using this term in its ecological sense to include the parent rock, soils, water, climate, plants and animals of the region.

It is generally agreed among geologists that the Ozarks comprise one of the oldest land areas on our continent. Originally this land was level and we know that it was inundated in very early times by a succession of inland seas, on the floors of which were laid down thick layers of dolomitic limestones. These were, of course, made up of the skeletal remains of the many life forms which inhabited the waters. Then countless centuries ago—perhaps as much as 500,000,000 years ago—this level plain was pushed upward by violent internal pressures. Mountains were formed which rose 5000 feet or more above the plain; and now the ample rainfall of the region began to cut great gullies and river channels.

Some of the rainfall, however, soaked into the soil — discovering here the cracks in the limestone created by the faulting of the uplift. Mild acids, formed by organic matter in solution, acted slowly to dissolve the rock; and through the milleniums great underground reservoirs and rivers began to form. As surface streams eroding

downward cut across these underground rivers, they emerged as springs along the valleys.

There came a later period when a second uplift occurred, causing the valleys and river channels to dig still deeper into the overburden and the rock formations beneath the plain. Ground water found new cracks in the dolomite at still lower levels and developed a second set of streams and reservoirs at this greater depth. And now the earlier channels above became great caves.

Geologists call this whole Ozark land mass a "plateau," although it is actually a vast system of rivers and gullies or hollows divided by steep ridges. Were it not covered today by a blanket of vegetation, it would be one of the great erosion spectacles of the world; as indeed it must have been, millions of years before man appeared on the scene. There are areas in the Ozarks, as in the St. Francois Mountains of Iron and St. Francois counties, where ridge-tops have eroded down to granite, or even through the granite

ALLEY SPRINGS

to the igneous rock, fired by the internal heat of the earth. Here the entire overburden has worn away through the centuries, so that the hills have lost several thousand feet of altitude. This erosion has taken place so slowly and over such a long period of time, however, that streams which traverse the Ozark country are not muddy or silt-filled as in areas of recent erosion like the Rockies, but run swift, clear, sparkling and cool.

We think of Ozark soils as poor. Yet this was not always true, for these soils are tremendously old and highly developed, in sharp contrast to the new soils found in the western mountains. These latter have not evolved the complexity to support more than a few species of plants and animals. Ozark soils, on the other hand, are highly complex in their virgin state. At the time the white man arrived in Missouri, they were supporting some 2000 plant species and at least 700 kinds of animals, birds, fishes, reptiles and amphibians.

It is hard to conceive today that when those first white men came they found in Missouri great herds of buffalo, deer, elk and wild turkeys. French traders, with the help of Indian hunters, secured for many years large supplies of wild meat in the grassy openings of the forest like those along St. Francois River and in Belleview Valley. Much of this meat was floated down the Mississippi to New Orleans in great dugout canoes which had a 50-foot length and 5-foot beam and were hollowed from giant cottonwood logs. One early woodsman described the land as "the best in the world for hunting, not even excepting old Kentucky." And fishing in the Ozark rivers was unsurpassed on the continent; the climax species being the black bass.

Much of the Ozark terrain was originally covered with forests of pine, oak, hickory and many other species; yet this forest was open and interspersed with grassy glades and prairies. Settlers found living here as easy as pioneer living can ever be; with the great abundance of fish and game—and plenty of forage for their horses, cattle, sheep and oxen. Eventually they found that hogs throve in the forest, growing fat on oak mast, hickory nuts and other nutritious foods. Thus for many years the people lived from the land, planting few crops except the kitchen garden which supplemented their livelihood from the forest.

As the country became more thickly settled, owners of livestock found that their cattle fared better where the woods had been burned; for on the

JACK'S FORK

Ozark streams are swift and clear, abound in bass and wall-eye.

Photograph by Charles Swartz.

virgin land this released nutrients in the ash to feed the native grasses and legumes. Thus annual burning of the woods "to tame the wildgrass" became a custom of the region which persists in a few places even today. As numbers of livestock increased and pressure on the small forest openings grew greater, trees started to encroach on the glades and natural grass prairies. And burning became a matter of desperate necessity to keep the timber from moving in.

It was not until about 1880 that the Ozark people turned to logging as a primary source of livelihood. The first cutting was in the areas of big pine which was easily turned into saw lumber and found a ready sale in the towns of the region. But it wasn't long until the cutting extended to white oak for bourbon barrels, hickory for handle stocks, oak for railroad ties and mine props—and small trees of all species for charcoal. Timber cutting in the Ozarks has always been characterized by "high-grading," cutting the best and leaving the worst until nothing but "worst" was left. Another honored custom was "Grand-mawing," which simply meant cutting trees on someone else's land and reporting to the sawmill that the logs had been cut "out on Grand-maw's place." And always the livestock farmer followed the unwise and wasteful cutting with fires in the slash to make the grass grow. What he didn't know was that fire killed out the deep-rooted and nutritious native grasses and legumes

GRANITE AND PORPHYRY ON THE ST. FRANCOIS RANGE.

—and encouraged the little annuals which sprout green in May and die with the first hot weather of July.

Real farming of the cut-over Ozark lands is a fairly recent innovation, the original method of cultivation having been to grow a kitchen garden and patch of corn in the creek-bottom as winter feed for hogs and cattle. No effort was made to husband the fertility of the soil and finally even the rich bottom fields were worn out, washed away by flash floods or so covered with gravel as to become almost barren. This kind of damage became worse and worse as the naked hills caused greater run-off and worse and more frequent floods. The thin land of the upper hills was abandoned when it failed to produce and new cut-over land was grubbed off for plowing. It is estimated that more than 25 per cent of the Ozark land, much of it long since abandoned, has been cleared and cultivated at one time or another.

As a result of this kind of logging and farming use—which might better be called abuse—the thin topsoil layer of 4 to 10 inches was eroded from the hills, leaving a mantle of useless white chert over much of the area. Now the rains, instead of soaking into the ground, ran off as overland flow. Stream channels once rich in aquatic life became choked with sterile gravel washed down from the hillsides. Fishing became almost a sport of the past and was no longer a reliable source of

EROSION PROBLEM IN THE OZARKS

food. The abundant grasses and shrubs on which the game herds had flourished were now gone, replaced by a dense and fire-scarred second-growth of such inferior species as post oak, black jack oak and hickory. Elk, buffalo, bear, beaver and passenger pigeon had long since disappeared entirely—and now the deer, turkey and small game species seemed on the road to extinction. The cattle industry, the timber industry, the tillable lands, the hunting and fishing—all the resources on which the Ozark people depended for a livelihood—were playing out.

In addition to these ills, the hard-packed and barren soils which had been deprived for a full century of their annual accumulation of litter were sick. No longer could they soak up rainfall, and now the life-sustaining substance of the land was leached and eroded away. Along with soil erosion, the substance which gives people the initiative and incentive to go ahead was also eroding away. With less rain soaking into the ground, ever-flowing streams and springs now ran intermittently. When rain came, it ran off in great gushes, causing floods and destruction in the lower valleys.

This was the state of the Ozarks in the early 1930's when at least a few Missourians began to be concerned about their failing resources. In those years, new laws were passed which made it possible for the Federal government to accumulate cut-over acre-

age in Missouri, and as a result two National Forests were established These eventually embraced some 1,600,000 acres in 14 Ozark counties. At about the same time, Missouri passed the Constitutional Amendment creating her now nationally famous non-partisan Conservation Commission, charged with the proper and scientific management of all the natural resources of the state. One of the first things developed by the Commission was its Forestry Division, headed and staffed by trained foresters.

These agencies of the state and federal governments brought new knowledge and concepts to bear on the problems of the forested hill country. Both were by nature opposed to fire, over-grazing, timber and watershed destruction. Both rapidly developed programs of education designed to inform the Ozark people of the need to conserve soil, water and forest cover. Both had the personnel necessary to cooperate with any and all individuals and organizations interested in the preservation of the forest resources. With the Forest Service came the Civilian Conservation Corps to work at road-building, tree planting and many other projects. Fire observation towers were erected on the National Forests and on State lands, telephone lines constructed and fire fighting crews built to combat the ever-present danger from forest fires.

There was a period of several years when the century-old custom of burning the woods continued to prevail. As late as 1936, forest rangers and CCC boys fought day and night throughout the fire season of spring and autumn, and it sometimes seemed as though no progress whatever was being made and that the problem of woods burning would never be solved. And yet today it seems plain that those of us directly concerned were simply so close to the problem that we "couldn't see the trees for the woods." Year by year, the acreage burned in the fire season went down. Small trained crews today are able to suppress the far smaller number of fires. Each year the Con-

servation Commission increases the amount of private land within its Fire Protection Districts and gets better cooperation from local residents, while fire is no longer a major problem on the National Forests. Now and then we'll still have a big fire of incendiary origin, set in a sort of rebellion against authority or because of a grudge between neighbors, but these are in the minority. Accidental fires from spring trash burning, campfires or cigarettes

still occur but seldom get far out of control.

There are many reasons for the better fire record. Good livestock prices during the late 1940's, plus "improved pasture programs" sponsored by the agricultural agencies proved to most farmers that they couldn't afford to let valuable stock run wild in the woods. Youngsters in every rural school took home to their parents new knowledge of what actually happens when the woods are burned each year. On the National Forests, timber growth reached the point where rural people found employment in the harvest; cutting the logs, hauling and working in the sawmills. Public sentiment now frowned on woods burning, and farmers and townsmen allied to suppress fires when they started.

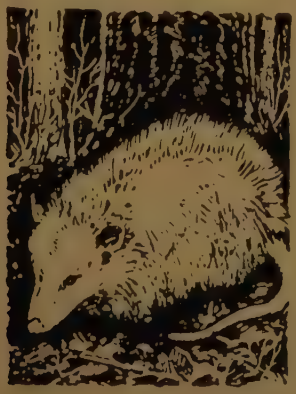
During the first years of the new conservation program, results seemed to be coming slowly. On the poor, eroded National Forest lands there was little or no marketable timber left; while on private lands the tendency was still to cut each tree the moment it would make a railroad tie, 8-foot saw-log or even fence-post or mine-

prop. Yet in lands protected from grazing, fire and over-cutting, a change was taking place. One of the interesting jobs undertaken by the U. S. Forest Service on their lands was the harvest of such old fire-scarred trees as would make some lumber. As this was sold and removed, part of the proceeds were used for girdling the remaining cull trees wherever there were good stands of young timber—and even chopping out of the undesirable "weed" species.

This release work, known as TSI or Timber Stand Improvement, returned countless tons of organic matter to the forest floor and released plant nutrients which had been tied up in the old cull trees for a half century or more. Added to the annual litter which was no longer burned, this brought about a rebirth of soil fauna and flora which set to work to turn the woody plant residues into humus. Young oak and pine, with room above them to reach for the sun, and nutrients beneath them to feed on, doubled or even tripled in growth. Today this growth has reached a point where annual harvest of good saw-timber from the National Forests is approaching 50 million board feet per year, with a total value of about $500,000. Meanwhile the growth of timber for future harvest greatly exceeds this.

The record on privately owned timber lands in Missouri, unfortunately, is still not this good. Yet there are some tracts being well managed for future production and a larger acreage each year comes under the timber-farming program made possible by Missouri's forward-looking Forest Crop Law. Under this law, forest land which is protected from fire and over-grazing and on which timber is allowed to grow for selective harvest is given certain advantages. It is given a nominal valuation and tax rate during the years of growth, and the owner then pays a severance tax when timber is harvested, this tax based on the yield.

(To be continued)



MISSOURI VEGETATION AND AN ENGLISH MATHEMATICIAN

EDGAR ANDERSON

I SUPPOSE it was from Sir Ronald Fisher that I acquired the odd, but effective, approach to biological problems of paying particular attention to what does *not* happen. Sir Ronald is the distinguished statistician, biologist, and natural philosopher with whom I spent part of my fellowship year in England in 1929-30. Though I cannot remember that we ever talked about it at the time, he has written in the introduction to one of his books that mathematicians differ from biologists not in the vigor of their minds but in the way they use them. Mathematicians, he writes, frequently operate by considering what does not happen, figuring out the consequences if it did, and from this round-about angle getting at the truth of the matter; biologists, he says, almost never use such an approach.

A typical example of this mathematical approach to a biological problem is the question I used to assign early each term in a course for amateurs in the Henry Shaw School of Botany at Washington University. "As you drive about the country side," I told them, "it's easy to keep your eye on the red cedars, particularly in the winter time. The chief question for your final exam is going to be: In what kinds of places in Missouri are there red cedars and in what kinds are there none? Why are they where they are and *why are they not where they are not?*" Given just a few hints, it was possible for most of the students to piece together from their own observations a pretty good beginning to an answer for this double-barreled question. A complete answer involves you in a very large problem (or net of problems) but by observation and deduction one can get quite a way into it.

One fact is pretty obvious. Red cedars are largely planted by birds. Young cedars come up in places where birds have been perching after they fed on the spicy gray-blue cedar berries. One repeatedly sees little cedar trees sprouting up alongside fence lines, particularly near the posts which make the best perching places. An old slippery-elm tree with wide spreading branches may eventually shelter a whole thicket of little cedars where the birds have dropped the seeds. Pastures do not begin to be dotted with cedars until enough old weeds are left unmowed to offer places where robins and bluebirds and cedar waxwings can alight and void some of the hard seeds from the cedars on which they fed.

Another point which one can figure out for himself is that cedars cannot tolerate very much shade and that the older they get the stronger is this thirst for sunlight. They may come up in the shade of a larger tree, but unless the tree dies or is cut down they do not live to maturity. In a deserted pasture they will grow rapidly in close competition with young oaks and hickories. In the early stages of reforestation there may even be more cedars than oaks on some hillsides but when

the broad-leaved trees grow high enough to shade the cedars, the latter pass out of the picture very quickly. Woodlands which have been so heavily pastured as to kill out most of the undergrowth and let in a lot of light may come up pretty thick with cedars but if the cattle are removed from the area the cedars die out when the shade thickens up again.

With this background of observation one begins to understand why cedars are so conspicuous on cliff edges and rocky hillsides. It is not that they really prefer the soil on such sites. Transplant one to a farmhouse lawn with good soil. So long as you give it plenty of air and sunlight it will grow faster and make a larger tree than its former companions up along the cliff. No indeed, red cedars have no inherent need of the barren conditions under which they often live. It is simply that under those extremes they can take it and most other trees cannot. There they have little competition except from each other.

This was a pretty good question, you see, to ask a group of interested amateurs. It is the kind of question which if a really good student once comes to grips with he will keep turning over in his mind for the rest of his life. The red cedar problem had a lot of angles, so many that it was quite as good a problem for the professor to think about as it was for the class. Intolerance of shade and the relation to birds are only two factors in the problem; there are many others, some of which still puzzle me. One in particular I should like to attack in a detailed, experimental way. That is, the various kinds of reactions of the red cedar to city conditions. It is well known, in a general way, that few conifers like city smoke, but the relation of red cedars to man is a many-faceted one. Smoke is only one element. Way out in the suburbs where the cedars look green and healthy they are being affected in other ways. This is a problem one can study every time he drives back into town from a trip in the country. Driving into the city one passes through the following zones:

1. Cedars healthy; seedlings coming up vigorously.
2. Cedars healthy; occasional seedlings.
3. Cedars healthy; no young self-sown seedlings.
4. Cedars fairly attractive if well cared for.
5. Cedars persisting in gardens when planted but obviously affected by city conditions.
6. No cedars.

The surprising part of the problem is how far out in the country zones 2 and 3 already extend. Of man's various impacts upon the countryside, which one or ones is responsible for stopping the cedars from reproducing themselves at the very edge of the city (zone 2 now falls between Ladue and Chesterfield), stopping not only the cedars but many other plants as well? Some of the plants in our flora are much less sensitive to man than the cedars, some much much more so. Every one which I have studied carefully is affected in some way or another. Nothing in the entire flora is

quite indifferent to man. If, for instance, you know the Korean Lespedeza, you can see the facts for yourself. It is an introduced plant but it reacts in much the same way as the native red cedars, though it is not so sensitive and spreads farther into the suburban area.

For a botanical garden well inside the city these are more than philosophical problems; they are of the utmost practicality. How are we to keep alive, in the middle of the city, something of the country? The harder it becomes to carry out such a program, the more important it is that we should keep on trying. On the one hand, we make headway both at the practical problems of caring for such areas and the scientific problems of why these plants react as they do. On the other hand, we keep alive for those who live and work in the city something, which if it is really not a piece of the country any more, still gives that effect to the casual passer-by.

BOOK REVIEW:—

Plant Propagation Practices, by James S. Wells. 344 pages. The Macmillan Co. New York, 1955. Price $7.50.

To plant propagators, the introduction of synthetic growth hormones, polyethylene plastic, and mist-making devices, over the past few years, looks like the discovery of the century. For all their astuteness, these artisans of the scion have not advanced greatly their basic methods in controlling heat, light, and water since the introduction of the Wardian case a hundred years ago. Now, almost over night, the use of these recently introduced materials has alleviated several of the inherent shortcomings long troublesome to propagators, particularly in rooting cuttings.

In the opinion of this reviewer, *Plant Propagation Practices* is an extraordinary and timely book. Mr. Wells writes from personal experience, and in most instances his conclusions are based upon carefully documented experiments. Particular emphasis is laid upon rooting cuttings by the new methods, although much basic material needed for a proper understanding of plant propagation in general is included.

Mr. Wells discusses with considerable verve a subject he has known since childhood, first in England under his father who was a "plantsman of the old school," and then in his own private nursery. Before coming to the United States, he was awarded the National Diploma of Horticulture, with honors, which is the highest award given by the Royal Horticultural Society in England. Since 1946, Mr. Wells has been employed as a propagator in several leading nurseries in eastern United States and in the Midwest where he has aroused considerable enthusiasm in the newer methods of plant propagation.

This book, in the words of the author, is written especially for "the young nurseryman who has recently decided to do some of his own plant propagation." It is well produced with an appealing format. Nearly 100 photographs and diagrams illustrate the text, and although the photographs are of varying quality the diagrams are generally well executed and clear. In my opinion, the photographs of grafting techniques would have been clearer as diagrams.

Mr. Wells' book should be considered more in the light of a handbook than a textbook. It is divided into five parts, thirty-two chapters and 327 pages of text.

Part 1 deals with the propagating unit itself, how to set it up and the equipment needed.

Part 2 is the shortest and the only theoretical part of the book but perhaps the most important in some respects. The significance of the photosynthetic process is clearly reaffirmed, and the basic requirements for plant growth, i.e. water, heat, and light, are rendered in sufficient detail for a clear understanding by the propagator.

Part 3 concerns propagating procedures. Under this heading, eight chapters cover seeding, propagation of cuttings, aids to rooting cuttings, humidification and constant mist, grafting, layering and division, pests and diseases, and the production of the

liner for field planting. The most important factors for taking cuttings, in the estimation of Mr. Wells, are timing (preferably before 9 A. M. for most plants), the correct rooting medium, and the follow-up in maintaining the proper balance of heat, light, and water for rooting. The chapter on aids to rooting cuttings lists 125 kinds of trees and shrubs and the proper hormone treatment for each. The reader should note, especially, the efficacy in using stronger hormone concentrations, such as 2 per cent indolbutyric acid for rooting certain kinds of difficult-to-root plants. Considerable emphasis is laid upon wounding many kinds of cuttings prior to treating with hormone powder. Regarding humidification, the use of intermittent mist for summer-time propagation of softwood cuttings introduces one of the newest follow-up methods yet devised for regulating humidity and temperature under full sunlight. By this method, many kinds of plants, such as magnolia, dogwood, and Japanese maples, long propagated on a commercial scale only by grafting, can now be rooted almost 100 per cent during the summer from softwood cuttings in full sunlight under a mist setup. The fact that hybrid French lilac cuttings taken in late spring can now be rooted successfully under intermittent mist fully justifies the use of this method for propagating "own root" lilacs. These and other examples lend to the book an extremely fresh and practical approach for the professional and amateur propagator alike.

Part 4 may be the most interesting for many readers who want to get down to the business of propagating specific kinds of plants. At this point, in a series of chapters, Mr. Wells discusses his results in propagating Japanese Maples, Azaleas, Boxwood, Camellias, Cypress, Dogwood, American Holly, Junipers, Magnolias, Rhododendrons, Hybrid French Lilacs, Yew, and Arborvitae. His experiments in rooting these plants by the newer methods is sometimes spectacular and most revealing for the would-be propagator with the view of profit in mind.

Part 5 presents a useful month-by-month work schedule for propagating various kinds of plants over the entire year. Information of this sort is not of easy access.

A most useful appendix lists sources for obtaining most of the materials used in the new propagation techniques by Mr. Wells, plus a number of pertinent references to recent literature on propagation practices. The veteran and amateur home gardener alike will find it difficult to lay down the book until the last chapter is finished.

F. G. Meyer

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SOME FACTS ABOUT SHAW'S GARDEN

The Missouri Botanical Garden (the official name chosen by Mr. Shaw) carries on the garden established by Henry Shaw over a century ago at TOWER GROVE, his country home. It is a private institution and has no support from city or state. The old stone walls and cast-iron fences, the Linnaean House, the Museum, the Mausoleum, and the TOWER GROVE mansion all date from Mr. Shaw's time. Since his death, as directed in his will, the Garden has been in the hands of a Board of Trustees who appoint the Director.

The Garden is open every day in the year (except New Year's and Christmas) from nine A. M. until seven P. M. (April to November) and until six (November to April) though the greenhouses close at five. TOWER GROVE, itself, Mr. Shaw's old country home, is open from one until four. The Garden is nearly a mile long and has several entrances. The Main Entrance, the one used by the general public, is at Tower Grove and Flora Place on the Sarah bus line (No. 42). The Park Southampton buses (No. 80), direct from downtown, pass within three blocks of this entrance and stop directly across the street from the Administration Building at 2315 Tower Grove Avenue. The latter is the best entrance for students, visiting scientists, etc. It is open to such visitors after 8:30 a. m., but is closed on Saturdays, Sundays, and holidays. There is a service entrance on Alfred Avenue, one block south of Shaw Avenue.

Since Mr. Shaw's time an Arboretum has been developed at Gray Summit, Mo., adjacent to State Highways 50 and 66. It is open every day in the year and has two miles of auto roads as well as foot trails through the wild-flower reservation. There is a pinetum and an extensive display of daffodils and other narcissi from March to early May.